Project Delivery Network

Roadway Drainage Design QC Checklist

Version
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Introduction

The Project Delivery Network Roadway Drainage Design QC Checklist is to be used with the UDOT QC/QA Procedure. This checklist is a tool to assist the project team in verifying all work is produced with due diligence, using acceptable industry standard techniques, available resources and data, and reasonable decisions by competent professionals. The checklist is a tool for the delivery of quality documents and cannot replace the sound judgment and experience of competent professionals. It is the Design Team's responsibility to verify the quality of project documents **before** distribution.

Checklist Instructions

For each deliverable listed, the QC Checker is to verify all items listed in the checklist are complete, along with any additional items the QC Checker deems necessary. The checklist items are not to be interpreted as the only items that need to be verified.

Once all items are verified, the QC Checker is to sign the associated cover sheet and upload it onto ProjectWise. The QC is not complete until the cover sheet is signed, dated, and uploaded onto ProjectWise. See the Project Delivery Network QC/QA Procedure for the appropriate cover sheet.

QC reviews are to be completed **before** distribution.

The following explanations are to aid in completing the QC checklist items:

- A checklist item deemed "complete", "correct", or "accurate" does not denote that the item is perfect, but rather that the item satisfies design criteria based on known information, acceptable techniques, and sound judgment."
- A checklist item deemed "addressed" denotes the item as "reviewed all known concerns and verified the concerns are appropriately mitigated and satisfy design criteria." Addressed concerns are not necessarily incorporated into the design, but satisfactorily mitigated.
- A checklist item deemed "identified" denotes the item as "an acceptable and economical approach to satisfy design criteria based on known information."
- A checklist item deemed "verified" denotes the item as "verified the approach/conclusion as acceptable based on known information."
- Use check boxes to verify checklist items are complete. If a checklist item is *not applicable* to the current project, place an NA over the check box to denote the item as not applicable. This will allow the quality assurance to verify all items were addressed.
- Use the comment sections of the Cover Sheets to address exceptions, assumptions, and unique aspects of the project. The comments will help others understand why certain decisions were made and their impacts on the project.

1Q1 Assess Existing Roadway Drainage Conditions

Review existing conditions and develop recommendations for improvements.

References

1. UDOT Drainage Manual of Instruction
2. UDOT Project Delivery Network
3. UDOT QC/QA Procedures
4. UDOT Practical Design Guide

Preliminary Drainage Summary

1. ☐ A hydraulics folder is in the project's ProjectWise folder.
2. ☐ A field visit was conducted.
3. ☐ Existing drainage features were inspected.
4. ☐ The designer coordinated with maintenance and their comments are documented and addressed.
5. ☐ Available existing roadway and structures drawings were obtained and reviewed.
6. ☐ Coordinated with the survey team to obtain necessary survey data.
7. ☐ Coordinated with the local entities to consider their storm water master plan.
8. ☐ Drainage Design Criteria were created following the guidelines in Drainage Manual of Instruction and the following items are addressed:
    a. ☐ Hydrology
    b. ☐ Roadway Drainage
    c. ☐ Storm Drains
    d. ☐ Culverts
    e. ☐ Under Drains
    f. ☐ Irrigation Systems
    g. ☐ Ditches
    h. ☐ Major Structures (bridges, box culverts, etc.)
    i. ☐ Detention/Retention Ponds
    j. ☐ Clear Zone Design Constraints
    k. ☐ Water Quality
9. ☐ Confirmed the recommended drainage improvements, including the following:
    a. ☐ Preliminary capacity needs for each drainage facility
    b. ☐ Existing hydraulic facilities suitability to convey calculated flows
    c. ☐ Possible deficiencies due to the proposed project

1Q1 Continued

d. ☐ Capacity and physical condition of existing facilities

e. ☐ Approximate size and location of new facilities

10. ☐ The cost estimate addresses all recommended drainage improvements with appropriate risk considerations and contingencies.

11. ☐ The roadway drainage summary contains all available information, summarized in a clear and concise format, and the following items:

    a. ☐ Location of existing drainage and irrigation facilities and identifies their ownership, size, material, and condition

    b. ☐ Location and nature of recommended improvements

    c. ☐ Priority of recommended improvements

    d. ☐ Construction phasing and limitations considerations

    e. ☐ Environmental commitments and permits required

    f. ☐ Preliminary drainage cost estimate

    g. ☐ Design activities

    h. ☐ Drainage Design Criteria

2Q1 Develop Initial Roadway Drainage

Develop preliminary roadway drainage

References

1. UDOT Drainage Manual of Instruction
2. UDOT CADD Standards
3. Preliminary Drainage Summary (1Q1)
4. UDOT Project Delivery Network
5. UDOT QC/QA Procedures
6. Estimate Review Checklist
7. UDOT Practical Design Guide

Initial Drainage Design Layout

1. ☐ All review and maintenance comments are addressed, incorporations complete, and the comment resolutions sent to the design leader.
2. ☐ Hydrologic methodology is identified with hydrology and flows for each feature.
    a. ☐ Design storm intensity and frequency were correctly determined.
    b. ☐ Time of concentration was correctly determined.
3. ☐ All necessary drainage features are identified.
4. ☐ Conveyance methods (pipe, ditch, culvert, etc.) are identified.
    a. ☐ Preliminary storage needs are correctly determined.
    b. ☐ Ultimate outfall locations are identified.
5. ☐ Detention/retention basin locations are identified.
6. ☐ The roadway profile was reviewed by the hydraulic and roadway design teams.
    a. ☐ Potential conflicts are identified.
    b. ☐ Recommended features potentially inside the clear zone or ROW are identified.
7. ☐ Initial drainage design layout is ready for distribution.
8. ☐ Identified and coordinated all additional survey needs with the survey team.
9. ☐ Identified and coordinated all potential utility conflicts with the utility team.
    a. ☐ Requested necessary SUE data for utility conflicts.
10. ☐ Identified and coordinated potential ROW impacts with the ROW team.
    a. ☐ Requested required easements.

Preliminary Drainage Cost Estimate

1. ☐ The roadway drainage cost estimate was verified through the Estimate Review Checklist (found at the end of this document).

2Q2 Develop Initial Irrigation Design

Layout the initial irrigation design.

References

1. UDOT Drainage Manual of Instruction
2. UDOT CADD Standards
3. UDOT Project Delivery Network
4. UDOT QC/QA Procedures
5. Estimate Review Checklist
6. UDOT Practical Design Guide

Initial Irrigation Design Layout

1. ☐ The designer met with the Irrigation Company.
2. ☐ Existing irrigation system is correctly modeled based on known information.
    a. ☐ Known flow splitting and metering elements are included.
3. ☐ Initial pipe sizes and ditch geometry adequately meet known design requirements.
4. ☐ Preliminary locations of diversion structures and flow measurement elements are determined and adequately meet known design requirements.
5. ☐ Identified and coordinated all additional survey needs with the survey team.
6. ☐ Identified and coordinated all potential utility conflicts with the utility team.
    a. ☐ Requested necessary SUE data for utility conflicts.
7. ☐ Identified and coordinated potential ROW impacts with the ROW team.
    a. ☐ Requested required easements.

Preliminary Irrigation Cost Estimate

1. ☐ The irrigation cost estimate was verified using the Estimate Review Checklist (found at the end of this document).

3Q1 Complete Roadway Drainage Design

Develop the roadway drainage and/or open channel drainage features.

References

1. UDOT Drainage Manual of Instruction
2. UDOT CADD Standards
3. UDOT Standard and Supplemental Drawings
4. UDOT Plan Sheet Development Standards
5. UDOT Project Delivery Network
6. UDOT QC/QA Procedures
7. Estimate Review Checklist
8. UDOT Practical Design Guide

Roadway Drainage Design

1. ☐ All review comments are addressed and the comment resolutions sent to the Design Leader.
2. ☐ All revisions based on comments are complete.
3. ☐ Hydraulic models of project features were created and calculations for the models are correct.
4. ☐ Routing of check flood was performed based on table 7.A-1. (1)
5. ☐ The storage facility design adequately meets project requirements:
    a. ☐ Inflow hydrograph developed correctly.
    b. ☐ Storage volume breakout is correctly calculated.
    c. ☐ Grading and depth requirements adequately meet project requirements.
    d. ☐ Outlet locations are appropriate.
        i. ☐ Release rates are appropriately analyzed.
        ii. ☐ Control structures design is adequate.
        iii. ☐ Energy dissipation is appropriately evaluated.
    e. ☐ Provisions for maintenance (such as berms and access ramps) are adequate.
6. ☐ Storm inlet design adequately meets design and project requirements.
    a. ☐ Correct design inlet spacing per design criteria.
    b. ☐ Achieves minimum time of concentration (1)
    c. ☐ Achieves maximum access spacing (1)
    d. ☐ All sag points and existing drainage nuisances are identified.
    e. ☐ Debris and clogging of storm drain inlet is adequately addressed.
    f. ☐ Correct grate/rim elevations for drainage structures

7. ☐ Storm drain design adequately meets design and project requirements.
    a. ☐ Minimum and maximum velocities are maintained. (1)
    b. ☐ Minimum pipe sizes are maintained. (1)
    c. ☐ Hydraulic grade lines (HGLs) are one foot or more below the finished grade pavement surface at all times for the design storm.
    d. ☐ Storm drain material selection is appropriate. (1)
    e. ☐ Appropriate energy dissipation needs
    f. ☐ Flood inundation of storm drain system is appropriately analyzed.
    g. ☐ Environmental restrictions of water quality for outfall are met.
    h. ☐ Vertical profiles for pipes and ditches meet project and design requirements.
    i. ☐ Earthwork is correctly calculated.
8. ☐ Culvert design adequately meets design and project requirements.
    a. ☐ Design storm frequency is appropriate. (1)
    b. ☐ Culvert design limitations are maintained. (1)
    c. ☐ Minimum culvert size maintained.
    d. ☐ Headwall and end-sections placed appropriately. (1)
    e. ☐ Culvert material selection is appropriate. (1)
    f. ☐ Energy dissipation correctly evaluated.
9. ☐ All potential utility conflicts with drainage features are identified and coordinated with the utility team.

Preliminary Drainage Plan and Profile Sheets

1. ☐ All preliminary plan sheets conform to UDOT Plan Sheet Development Standards. (4)
    a. ☐ All sheets are cut appropriately.
    b. ☐ All reference files are properly attached.
    c. ☐ Plan sheet CADD standards are followed and maintained on each sheet.
2. ☐ All labels, callouts, and information necessary for a plan-in-hand review of the drainage design are included and correct.
3. ☐ Profiles are displayed along the conveyance feature, not the roadway.

Drainage Cost Estimate

1. ☐ The roadway drainage cost estimate was verified using the Estimate Review Checklist (found at the end of this document).

3Q2 Complete Irrigation Design

Complete the layout of irrigation features.

References

1. UDOT Drainage Manual of Instruction
2. UDOT CADD Standards
3. UDOT Standard and Supplemental Drawings
4. UDOT Plan Sheet Development Standards
5. UDOT Project Delivery Network
6. UDOT QC/QA Procedures
7. Estimate Review Checklist
8. UDOT Practical Design Guide

Irrigation Design

1. ☐ All review comments are addressed and the comment resolutions sent to the Design Leader.
2. ☐ All revisions based on comments are complete.
3. ☐ Irrigation design meets design and project requirements.
    a. ☐ Appropriately calculated design flow data for both normal and peak flows
    b. ☐ Acceptable hydraulic performance for design flow and operational head
    c. ☐ Correct rim elevations for diversion structures
    d. ☐ Acceptable vertical profile for irrigation pipes and ditches
    e. ☐ All irrigation culverts extend from one ROW boundary to the other.
    f. ☐ Pipe material selection is appropriate.
4. ☐ Hydraulic details meet design and project requirements.
    a. ☐ All diversion points are re-established (unless there is written notification for abandonment).
    b. ☐ Flow measurement devices and locations are appropriate.

Preliminary Irrigation Plan and Profile Sheets

1. ☐ All preliminary plan sheets conform to *UDOT Plan Sheet Development Standards*
    a. ☐ All sheets are cut appropriately.
    b. ☐ All reference files are properly attached.
    c. ☐ Plan sheet CADD standards are followed and maintained on each sheet.
2. ☐ All labels, callouts, and information necessary for a plan-in-hand review of the drainage design are included and correct.
3. ☐ Profiles are displayed along the conveyance feature, not the roadway.

Irrigation Cost Estimate

1. ☐ The irrigation cost estimate was verified using the Estimate Review Checklist (found at the end of this document).

4Q1 Complete Drainage/Irrigation Plan Sheets and Documents

Revise the drainage and irrigation designs based on the plan-in-hand review. Complete drainage and irrigation plan set and documents. Finalize the hydraulics report.

References

1. UDOT Drainage Manual of Instruction
2. UDOT Plan Sheet Development Standards (PSDS)
3. UDOT CADD Standards
4. UDOT Standard and Supplemental Drawings
5. UDOT Standard and Supplemental Specifications
6. Specification Writer's Guide
7. Measurement and Payment Template
8. Acceptance and Documentation Guide
9. UDOT Project Delivery Network
10. UDOT QC/QA Procedures
11. Estimate Review Checklist
12. UDOT Practical Design Guide

Drainage/Irrigation Plan Sheets

1. ☐ All review comments are addressed and the comment resolutions sent to the Design Leader.
2. ☐ All revisions based on comments are complete.
3. ☐ All design revisions conform to design standards and meet project requirements (see previous checklist items as needed).
4. ☐ All drainage and irrigation plan and profile sheets conform to UDOT plan sheet development standards. (See (2) – General Plan Sheet Requirements)
    a. ☐ *PSDS General Plan Sheet Requirements* are followed. (2)
    b. ☐ Call-out rules are followed.
    c. ☐ All title blocks are filled out correctly.
    d. ☐ Plan Sheet CADD standards are followed and maintained on each sheet.
    e. ☐ All necessary notes, callouts, legends, etc. are included, correct, and neatly organized.
    f. ☐ All pay item callouts match the engineer's estimate pay items.
5. ☐ **Drainage/Irrigation Plan and Profile Sheets** are complete
    a. ☐ All pipes, culverts, inlets, etc. are identified and correctly numbered.
    b. ☐ All existing and proposed drainage features are correctly identified and labeled.
        i. ☐ Existing water features (river, stream, creek, lake), canals, ditches, and pipes
            1. ☐ Dimensions and/or cross sections
        ii. ☐ Proposed conveyance methods are correctly identified (pipe, ditch, culvert, etc).

1. ☐ Dimensions and/or cross sections
2. ☐ Slopes
3. ☐ Design flows and velocities
4. ☐ Hydraulic grade lines
5. ☐ Inflow and outflow elevations
6. ☐ Energy dissipation locations and methods

iii. ☐ Profiles are along the conveyance feature, not the roadway.

c. ☐ Proposed drainage structure grate/rim elevations are correct.

d. ☐ All utility conflicts are indicated on both the plan and profile.

6. ☐ **Detail sheets** are complete (See (2) – Detail Sheet Requirements).
   a. ☐ All necessary details to build the project are included.
   b. ☐ The *PSDS DT Sheet Checklist* items are complete.
   c. ☐ All details are labeled and dimensioned completely and correctly (2).
   d. ☐ All necessary labels, callouts, identifiers, symbols, and notes are provided and correct.
7. ☐ **Summary Sheets** are complete. (See (2) – Summary Sheet Requirements)
   a. ☐ The *PSDS Summary Sheet Requirements* are followed and complete.
   b. ☐ UDOT standard summary sheets are used.
   c. ☐ All pay items are included in the summary.
   d. ☐ All quantities are calculated correctly.
   e. ☐ All pay item names, alignment designations, stations, offsets, units, and quantities are correct.
   f. ☐ All summaries are exported from Excel to Microstation and the sheets are updated with the current Excel version.
   g. ☐ All summary items and quantities are entered into PDBS.

Drainage/Irrigation Project Documents

1. ☐ The **Special Provisions** are complete. (4)
   a. ☐ All special provisions conform to the Specification Writers' Guide (verify using Chapter 11 Checklist). (4)
   b. ☐ A special provision has been created for each non-standard item.
   c. ☐ All general and project specific special provision content is accurate, complete, and does not contain anything unnecessary.

4Q1 Continued

2. ☐ The **Measurement & Payment** is complete. (5)
    a. ☐ All M&P items match pay items exactly.
    b. ☐ For all non-standard pay items, a complete and correct M&P description of all effort and materials is included.
    c. ☐ All units are correct.
3. ☐ The **Acceptance & Documentation** is complete. (6)
    a. ☐ All A&D items match pay items exactly.
    b. ☐ PDBS was used to generate A&D for all pay items.
    c. ☐ For all non-standard pay items, a complete and correct A&D is included.

Final Drainage/Irrigation Cost Estimate

1. ☐ The cost estimate was verified using the Estimate Review Checklist (found at the end of this document).

Estimate Review Checklist

Provide review checklist of all design cost estimates.

References

1. Estimating – Roadway Design Manual of Instruction (Section 7.19)
2. Estimator's Corner Website
3. UDOT Project Delivery Network
4. Project Development Business System

Estimate (applies to every stage for updating the estimate)

1. ☐ All necessary bid items are included.
2. ☐ All quantities and units are correct.
3. ☐ All standard bid items match UDOT standard bid items exactly.
4. ☐ Unit prices were estimated using UDOT approved methods (PDBS, local contractors, etc.).
5. ☐ All unit price estimates are documented.
6. ☐ Unit prices reflect the following: (1)
    a. ☐ Location
    b. ☐ Time of year for advertising
    c. ☐ Complexity of Constructability
    d. ☐ Quantity of item
    e. ☐ Limitations of operation
    f. ☐ Current bidding environment
    g. ☐ Availability of materials
    h. ☐ Familiarity of a process
    i. ☐ Specialty equipment
    j. ☐ Risk to contractor
    k. ☐ Inflation
    l. ☐ Construction schedule
7. ☐ Lump sum bid prices are used only when appropriate. (i.e. unit pricing is too difficult).
8. ☐ All lump sum bid prices considered the following: (1)
    a. ☐ Contractor risk due to unknown quantity.
    b. ☐ All materials and labor involved.

Additional PS&E Estimate

9. ☐ All bid items, quantities, and units match the plan sheet callouts, summary sheets, and M&P exactly.